THE MINERAL INDUSTRY

ITS

STATISTICS, TECHNOLOGY AND TRADE

DURING

1911

FOUNDED BY RICHARD P. ROTHWELL

EDITED BY

CHARLES OF
Mining Engineer

VOLUME XX

SUPPLEMENTING VOLUMES I TO XIX

McGRAW-HILL BOOK COMPANY
239 WEST 39TH STREET, NEW YORK
6 BOUVERIE STREET, LONDON, E. C.
1912

THE·MAPLE·PRESS·YORK·PA

PRECIOUS STONES

By George F. Kunz

It is remarkable that in the face of a universal financial depression the prices of diamonds and pearls have advanced considerably since 1906, and this after only one year's shutdown of the great group of diamond mines and with no attempt to regulate the price of pearls. The imports of precious stones have remained constant, but were less than in 1906, a banner year and the result of overbuying. The effect of the small importation in 1908 was the selling down of the old stocks, which in turn led to the greater imports of 1909, 1910 and 1911.

However, the upward trend of prices, is clearly apparent when we compare the average prices of the uncut, rough diamonds for 5-year periods for the last 20 years: 1891 to 1895, average price per carat 26s. 9.45d.; 1896 to 1900, 29s. 1.15d. per carat, increase in price, 8.6 per cent.; 1901 to 1905, 47s. 3.36d. per carat, increase, 62.5 per cent.; 1906 to 1910, 55s. 7.93d. per carat, increase, 17.7 per cent. The diamond syndicate advances on the price of rough diamonds when sold to the diamond cutters have been as follows: June, 1906, 4 per cent.; May, 1907, 3; June, 1909, 5; June, 1910, 2 per cent.

The value of the precious stones, cut and uncut, brought into the United States in 1911, is about $42,163,164 as against $42,315,830 for 1910. From fiscal year figures, 1912 will exceed this.

Standard of Weight.—The general adoption of a uniform standard for dealings in precious stones, based upon the metric carat of 200 mg. is a matter much to be desired. The carat has heretofore varied somewhat in different countries, resulting in some confusion and inconvenience in business. The metric carat has now been formally adopted in most of the countries of Europe, and its use made compulsory. Our own country and Great Britain, however, have thus far taken no action in this matter. Many of our dealers and importers recognize the theoretical advantage and inconvenience of the change, but do not take any active interest in it, apparently, as a practical reform. This matter is giving Germany and France a great lever in international trade. But the change must come ere long. A single standard for all countries, and the substitution of decimal for common fractions in the carat, are advantages so plain that they must surely soon be realized.

A striking illustration of the defectiveness of the system hitherto in

use, as compared with the standard metric unit, is given in a recent article by Mr. L. S. Spencer, of the British Museum, on "The Larger Diamonds of South Africa."[1] Mr. Spencer tries with care to clear up some published errors and misstatements as to the great diamonds obtained in recent years from the African mines. But it proved impossible to obtain the precise weights of some of these notable stones, especially those of the earlier discoveries, on account of the uncertainty as to what carat-weight was employed. The present English "Board of Trade" carat is 205.304 mg., while the "old" English carat, prior to 1888, was 205.409 mg., and the French "international" carat is 205 mg. Hence with some of the stones, only an approximate statement of their original weight is now possible.

The writer first suggested[2] dividing the carat into 100 parts, the carat to be 200 mg. each; that is, five diamond carats to the gram, or 20 pearl grains, or 5000 carats to the gram, and 20,000 gr. in a milligram.

The subject of various diamond carats, their incongruity and the confusion of values of historic gems is fully treated by the writer.[3]

Diamond

According to recent figures[4] the 1911 production and values of the South African Union are: De Beers, 1,924,225 carats, valued $24,690,430; Premier, 1,774,206 carats, $7,169,850; Jagersfontein, 338,831 carats, $4,968,895; Koffyfontein, 123,933 carats, $1,473,165; other mines and the Voorspoed will bring the Union product to 4,891,998 carats valued $43,743,620.

In the De Beers mines the year may be considered fairly successful, although the profit on all operations amounted to £2,270,291, against £2,690,726 in the preceding year; but the decrease, as noted by the chairman of the De Beers Company is due to the fact that in the year ending June 30, 1910, many sales were made out of the accumulated stock, thus unnaturally increasing the apparent output. In the actual output there was a gain in 1911, and the prices increased 3 per cent. or 4 per cent. over those secured in 1910. Dividends were paid to the amount of £800,000 on the preference shares and £1,000,000 on the deferred shares —equivalent to 40 per cent on each class of stock. The Reserve Fund, which amounted to £968,905 in 1900, stood at £1,337,953 on June 30, 1911.

The cost of production increased slightly in 1911 in the De Beers

[1] *Mineralogical Magazine*, London, 1912.
[2] Before International Congress of Weights and Measures, World's Columbian Exposition, 1893.
[3] George Frederick Kunz and Charles H. Stevenson, "The Book of the Pearl," New York, 1907, pp. 321–329.
[4] *N. Y. World.*

and Kimberley mines, but decreased considerably in all the others of the group—the figures per load being as follows:

	1910.	1911.
De Beers—Kimberley	8s. 5.29d.	8s. 7.67d.
Wesselton	5s. 5.82d.	4s. 9.09d.
Bultfontein	4s. 4.48d.	3s. 11.45d.
Du Toitspan	5s. 5.34d.	4s. 7.09d.

The margin of profit per load was greatest (10s. 10.235d.) in this latter mine, as in the preceding year.

The yield of diamonds per load has continued to decrease, except in the Bultfontein mine, where it showed a slight advance. The data on these points are as given below. It should be noted, however, that the De Beers has not actually been worked since 1908, the mine being in course of re-equipment, and all the diamonds accredited to that mine came from the deposit-floors.

THE OUTPUT OF THE DE BEERS CONSOLIDATED MINES, LTD.

Mine.	Loads Hauled. (a)	Loads Washed.	Yield per Load. Carat.	Value per Carat.	Value per Load.
1911.					
De Beers } Kimberley }	445,169	1,402,894	.28	46s 7.79d	19s 7.11 d[1]
Wesselton	2,422,487	1,423,117	.27	37s 9.6 d	10s 2.47 d
Bultfontein	2,457,412	1,866,212	.38	35s 0.52d	13s 3.79 d
Du Toitspan	2,780,070	2,335,240	.21	73s 6.5 d	15s 5.325d
	8,105,138	7,027,463			
1910.					
Be Beers. } Kimberley }	431,339	1,808,734	.38	47s 9.25d	18s 1.83 d
Wesselton	1,702,237	2,139,738	.32	34s 3.58d	10s 11.7 d
Bultfontein	2,099,173	1,818,509	.37	33s 1.62d	11s 10.68d
Du Toitspan	878,755	917,175	.23	68s 1.46d	15s 8.02 d
	5,111,524	6,684,156			

[1] Figures are different from those in printed statement.
(a) One load = 1600 lb.

The total number of carats of diamonds secured in the 2 years from these mines as computed from the average per load washed is:

	1910.	1911.
De Beers. } Kimberley }	687,319	392,810
Wesselton	684,716	384,241
Bultfontein	672,848	709,160
Du Toitspan	210,950	409,400
	2,255,833	1,895,611

The actual result of the year's production was £4,938,086, and the revenue from all sources, £5,928,830. Expenses of all kinds reduced this to a net profit of £2,998,616. Out of this were paid the dividends above mentioned, and Government taxes for the previous year, £310,137, and in part for the current year, £265,458, leaving a final balance of £623,019.

In one important respect the figures for 1911 differ from those for 1910; while in 1910 there were washed 1,572,632 loads more than were hoisted; in 1911, the excess of loads hoisted over those washed was 1,077,675. This has increased the stock of blue ground to 8,416,372 loads. Including 604,654 loads of lumps, there were in all 9,021,026 loads, entered on the balance sheet, at a cost price of £1,414,209. During the year ending June 30, 1911, as many as 2,359,021 loads of tailings were washed, yielding 256,631 1/4 carats of diamonds. This added to the production of these mines as given above, makes a total of 2,152,242 carats of diamonds produced in the year.

There was but little change in the depths of the shafts in the De Beers group of mines during the financial year 1911, except in No. 10 Prospect shaft of the Kimberley mine, which was deepened 400 ft. The main rock tunnel on the 3520-ft. level of the Kimberley mine was holed April 15, 1911, its total length being 1,154 ft.

DEPTH OF DE BEERS MINES.

De Beers	Main rock shaft	2,466 ft.
	No. 1 shaft	1,670 ft.
Kimberley	Main rock shaft	3,601 ft.
	No. 10 Prospect shaft	3,520 ft.
Wesselton	Main rock shaft	1,119 ft.
Bultfontein	No. 1 Main rock shaft	780 ft.
	No. 2 Main rock shaft	1,084 ft.
Du Toitspan	No. 1 Main rock shaft	860 ft.
	No. 2 Main rock shaft	768 ft.

The De Beers Company seems again coming into the lead of the diamond-supply, as the richness and quality of the Premier mine appear to be declining, and the output of German South Africa has not continued to increase. The company has also won an important success in a recent suit against the Rhodesian Chartered Co., the Privy Council having decided that the former has a right of claim to all diamonds found in Rhodesia.

The *total* output of the De Beers group of mines up to 1911 may be estimated at the enormous figure of 67,000,000 carats, worth over £100,000,000, or half a billion of dollars. If to this be added the yield of the Premier and other less extensive mines, and that of German Southwest Africa, the total may be placed at $600,000,000, which will

be doubled again by the costs of cutting, etc. Yet notwithstanding this vast production, the prices continue in a steady advance.

The 89,676,316 loads of material taken out of the De Beers' group of mines alone, from 1889, the date of the consolidation of these mines, to June 30, 1910, would constitute a mass 500 ft. square and 5736 ft. high; and yet if the diamonds derived from this blue-ground could be packed into a case 5 ft. square and 4 ft. high, the case would weigh 26,967 troy pounds, and be worth $405,000,000.

If we add the product of the great Premier mine, from 1901 to October 31, 1910, 36,839,926 loads, the volume will be 500×500×8096 ft.—over a mile and a half. The case of diamonds would gain a little less than a foot in height to accommodate the 10,581,041 carats of diamonds from the Premier mine; it would then hold diamonds weighing 59,611-581 1/4 carats, weighing 32,773 troy pounds and worth $450,000,000.

How much more precious diamonds are than gold is shown by the fact that 32,773 lb. of that metal would only be worth $8,100,000, the ratio being about 1 to 55 1/2. Of course, this refers only to rough diamonds, many of them very small, for a brilliant-cut diamond weighing but one carat is worth nearly 1000 times its weight in gold, and the disparity increases at an exceedingly rapid rate in the case of larger diamonds.

Vaal River.—Bloemhof, the Vaal River, is some 200 miles southwest of Johannesburg. The field here known as Klipfontein, has an extent of 12 square miles, and was officially opened up as an alluvial digging in 1907. More recently deposits of greater premium were discovered at Mooifontein, 17 miles from Bloemhof, and here an area of about 700 acres was opened for diggings September 13, 1911, and another area of 900 acres was soon to be proclaimed here also. The diamond gravel in this region is overlain and concealed by from 6 in. to 1 ft. of soil. It lies on a bed of andesitic lava (amygdoloidal diabase) whose irregular surface affords depressions in which diamantiferous gravel has gathered. During the 6 months from April to September, 1911, diamonds weighing 10,575 carats were found at Bloemhof valued at $268,000. In general, the diamonds extracted 20 carats in weight, and one of 80 carats is said to have been found at Vaalbosch Rush; this was estimated to be worth $5,000. The smaller stones have sold for as much as $22 or $23 per carat (88s. to 92s.). The chief center of activity, however, now, is Mooifontein where there are said to be gathered as many as 10,000 diggers, and about the same number of Kaffirs are employed. While the total output is not inconsiderable averaging about $160,000 monthly, the declared output of both Boemhof and Mooifontein for November was only $146,916. It will readily be seen that this total

gives but very meagre returns for each individual digger, although of course some are more fortunate than others.[1]

The diggers along the Vaal have been at the mercy of traveling buyers who pay what they please. A meeting was held recently at Austin's Rush, to plan for a better system. It was proposed to get the Transvaal Government to aid the diggers by a loan, to be repaid from the sale of diamonds, all under various precautions. Then a delegation or committee would come to America, where rough diamonds can be imported free of duty, and arrange for the Vaal River product to be sent here for sale and cutting.

The old Monastery Mine,[2] on which the New Star Diamond Mines, Ltd., hold on option, is being worked anew. It is stated to be the only "diamond-pipe" which appears in hard sandstone, and this rock seems to have favored the formation of large masses of the various minerals formed within it. An exceptionally large and fine zircon discovered here was at first believed to be a diamond, and Mr. Barney Barnato is said to have offered £1000 for the crystal. As a rule, the diamonds found in this mine are covered with an aluminous coating, not removable by acids, and rendering the stones unusually dull in appearance. Many of the diamonds are distinctly inferior, while others are very fine; one gem weighing 5 1/4 carats was valued at $2625. This mine appears to have been worked in ancient times, as human skeletons have been found in it at a depth of 40 ft. These are now in the Bloemfontein Museum.

German Southwest Africa.—Although large quantities of diamonds have been obtained here, it now seems as though the production would fall off. The predictions of Dr. Rohrbach and other investigators cited in our last report, give the impression of enormous resources for many years to come; but the practical results do not yet warrant any fear of overproduction.

The yield for 1911 was 798,866 carats which sold for $5,325,000,[3] and which was larger than in the year before; but the advance has not continued.

The returns of the German diamond companies show decreased dividends. The Kolmanskop Society, after paying 55 per cent. in its first year, reduced the dividend to 45 per cent. in the second year, while the dividend for the past year will be 30 per cent. Still more unsatisfactory is the showing of the German Diamond Company, which has cut its dividend in half, from 10 per cent. in the last year, and that of the Luderitz-

[1] Report of Consul Edwin N. Gunsaulus of Johannesburg, Dec. 22, 1912; *Daily Circular and Trade Reports*, Feb. 3, 1912, pp. 535-538.
[2] *Diamond Fields Advertiser*, July 24, 1911.
[3] *N. Y. World.*

bucht United Diamond Mines, which paid none. Increased cost of production and the tax of 33 1/3 per cent. on gross value levied by the Government upon exported diamonds, are factors in this poor showing. Indeed, many of the smaller companies have suspended operations until the desired change is made from a tax on gross value to a tax on proceeds.

The diamond deposits are now known to extend along the coast from about 24° to 25° south latitude, from Conception Bay nearly down to the mouth of the Orange River, but probably not very many miles inland. The country is a nearly level stretch of barren granitic rock, thinly covered with sand, which is swept to and fro by the wind, and piled up in shifting dunes. In these sands are the diamonds, small but brilliant octahedral stones, rarely over half a carat in weight, but cutting into fine gems. Stones vary in size and quality according to several sources. But those sources, which must have been extremely rich, are as yet a mystery. Some have thought that they have been brought by rivers formerly flowing from the interior highlands; others believe that their source is in diamond-bearing pipes or fissures now under the sea, whence they have been washed and blown with the sand, or swept in by currents in a period of former depression. This last view has been strongly advocated by Mr. M. E. Francis, of Johannesburg, an authority on diamond geology. The "blue-ground" region reported as found, has been carefully investigated, and large garnets as well as the so-called "carbonado," or ilmenite, have been obtained there, but no diamonds. In these investigations, as well as in other matters pertaining to these diamond fields, the German Colonial Secretary, Dr. Solfs, has been indefatigable.

A recent lecture on the geology of this region by Prof. Dr. Scheibe, before the Royal Agriculture High School in Berlin, describes the coast plateau as composed of ancient crystalline rocks, covered with the present loose sands and gravels, remnants from sedimentaries now eroded.

This account, however, does not solve the problem of the source of the diamonds. It may be noted that with them are found strewn through the sand, pebbles of chalcedony and agate of various colors, which did not come from the underlying granites and schists, and point to some other source, apparently in igneous rock.

The diamantiferous sands vary greatly in their richness. Near Luderitz Bay, the average may be taken as from three to five small diamonds per cubic meter. But in places where wind-concentration has occurred, the lighter material being blown away, the average may be eight or ten times as many; and in the Pomona district, ten or more diamonds of larger size may be seen on a square meter of surface, imply-

ing perhaps several hundred to the cubic meter. Again, there are other large areas where the yield is very scanty.

In many places the initial stages of washing on sieves are still entirely performed by hand, but these primitive methods have been largely superseded by the use of machinery.

By the introduction of the Schiechel sifting machines 90 per cent. of the diamonds are now secured, while only 60 per cent. were obtained under the older method of hand-working; it is also found that the introduction of these improved mechanical processes prevents theft. Since the German Government has taken entire control smuggling is almost impossible.

The output of the German diamond fields goes mainly to Antwerp for cutting, 90 per cent. or more being the proportion, and the small remainder goes to Berlin for cutting. An Antwerp syndicate takes charge of the main output, under an arrangement with the German companies somewhat like that of the London syndicate with the De Beers mines. The German Colonial Secretary, with the director of the German Diamond Company, has been visiting Hamburg, with the object of the possible opening of diamond-cutting industries there. The contract with the Belgian syndicate expires ere long; and it is probable that a German syndicate will be organized to take up the product of the mines and have it cut in German cities.

Australia.—The deposits at Copeton, New South Wales, are alluvial, the fields lying on the eastern watershed of the Gwyder River, some 18 miles south of Inverell. The diamantiferous gravel for the most part rests upon the granitic rock, and above it are overlying strata and basalt. This flow covers a wide extent of country, and erosion has left it in scattered hills and ridges. Below it are beds of river drift and gravel, sometimes many feet in thickness, the material being much rolled and waterworn. All are regarded as of tertiary age, the basalt-flow being subsequent to the river-drift. The conditions in this respect recall those in California, where diamonds occur in the old river-beds, overlain by a Tertiary lava-flow. The diamond-bearing gravel consists mainly of quartz, with much tourmaline, and some garnet, topaz, sapphire, a little gold, and an important quantity of tin ore. This latter helps to make mining operations profitable even if the diamonds would not suffice for this. As an instance when both diamonds and tin were found in considerable quantity may be cited the "Streak of Luck" mine, where a shaft was sunk 140 ft. into a depression in the granite bottom, in rich diamantiferous gravel, from a few inches to 9 ft. in depth, and yielding on the average for each load from 8 to 10 carats of diamonds and about 15 lb. of stream tin. These diamonds are said to have been

sold for 25s. per carat. This "pocket" was unusually rich. At the Ryder Brothers' mine, 5 miles south of Copeton, four men are stated to have found 2300 carats of diamonds in one year's work, the stones selling for 22s. and 23s. per carat. While the tin-bearing granites are known to exist in the vicinity, the source of the diamonds is another question and one of especial importance. A few small diamonds are said to have been found in a dolerite rock in a pipe or dyke form at the "Oakey Creek" mine, at the southern end of the diamantiferous belt. But as to this there is some question; and at best, a much richer matrix rock must be found to yield the quantity of diamonds found in these widespread gravels. Most of the diamonds from this region are small, from 1/8 carat to 3 carats; but they are of fine cutting quality, as indicated by the prices. The largest stone from the Copeton district is stated to have been taken from the "Star" mine; it weighed 7 carats. Besides the mines already mentioned, the "Round Mount," "Deep Shaft," and "Old Farm" mines, are among the most productive. All yield tin ore; and some, as the "Lone Star," "Soldier's Hill," and "Molacca" mines, are operated mainly for tin. Others are the "Banker," and "Kirk's Hill" mines, the latter adjacent to "Oakey Creek," where the occurrence of diamonds in basalt is reported. At "Kirk's Hill" mine, four loads of the wash furnished 1010 carats of diamonds and 2 cwt. of tin ore.

Frequently a land of ferruginous conglomerate is found, at various levels in the drift, evidently formed by deposit from iron solutions, and often forming a hard cement layer, from an inch to a foot in thickness. It may be quite productive, and strongly recalls the "cascallho" of Brazil. This material is thrown into a fire, when it crumbles, and is then easily crushed and washed, and the diamonds recovered. Frequently the deposits are reached by drifting into or under the basalt-capped hills.

The diamonds[1] of this region are very hard, requiring a long time to polish. They are mostly white, also yellow, brown, and occasionally of the rarer colored shades. Mr. Oscar G. Roberts, of Sydney, in a communication to the writer, states that for years, the diamond-seekers were unaware of the value of bort, and discarded it when met with. But of late, a demand for it has arisen for the diamond drills much used to develop the water-supply of Australia. The specimens found are true bort, not carbons; they resemble the white (not the yellow) diamonds occurring with them, in their hardness; the round pieces are set, together with Brazilian carbons. Good specimens on the field, are worth from 20s. to 80s. per carat, depending on size and quality. They are also sold for local use in china-drilling, etc.

[1] On the "Copeton Diamond Fields (N. S. W.)," *Australian Mining Standard*, April 20, 1911, p. 397, 8

A well-known mining expert, Mr. David Grove, is investigating the character of the diamantiferous area at Inverell, New South Wales, where he has acquired a half-interest in the pipe mining. He states that Mr. Levy, a well-known Amsterdam diamond-cutter, has pronounced the Inverell stones to be equal in brilliancy when cut to the best Brazilian, and also asserts that the statement made in South Africa, that Australian diamonds cannot be properly cut, is not founded in fact. Mr. Levy offers to purchase the output of the Inverell mines. Mr. Grove says he will make a comprehensive test to determine the value of the mine. If it proves a true pipe it will be found to contain large stones. If satisfied, cutters will come out to cut and polish the stones, thus establishing a new Australian industry.[1]

British Guiana.—The production of diamonds fell off from 1910, but showed an improvement in quality. The output is stated to have been 26,467 stones, weighing 3035 carats; while that of the year before was 85,537 stones, weighing 7180 carats. The number of diamonds produced was therefore less than one-third, but the number of carats fell only to three-sevenths. The stones of 1911 averaged nearly one-seventh of a carat, while the average of the year previous was only about one-twelfth of a carat. The obstacle to the development of diamond-production is the lack of communication and transportation. The only access is by boats and canoes, requiring a journey of 2 or 3 weeks.

Brazil.—It has long been known that diamonds occur in Goyaz, but there has been no important mining there. The newly discovered field reported recently in Brazilian papers lies in and along a little-known stream called the Garcas, a small affluent of the Aragura River, which flows northward to join the Amazon. The region is wild, and occupied only by a few Indians. A "rush" of diamond-seekers has already set in, and the neighboring states are stimulated to organize surveys and explorations in their stream-beds, in the hope of similar discoveries.

Canada.—An interesting discovery of diamond-occurrence, from a scientific point of view, though not from a commercial one, is reported from British Columbia, by Mr. Charles Camsell.[2]

Early in 1911, some specimens of chromite from the Tulameen District, B. C., obtained by Mr. Camsell, were analyzed by Mr. R. A. A. Johnston, and found to contain minute diamonds. The crystals break up on being freed from their matrix, but the fragments are clear and brilliant. The chromite occurs distributed in little veins and masses in peridotite rock. This rock appears as a stock, intruding sediments

[1] *The Mining Journal*, Vol. XCVII, No. 3999, p. 347; London, April 13, 1912.
[2] Private communication to the writer.

and flows of Triassic age, and has been much altered to serpentine, resembling thus the diamond-bearing peridotite of Arkansas, and perhaps the African kimberlite.

Analysis developed two parts or varieties in the chromite, one magnetic and the other non-magnetic. Diamond was present in the former to an extent of 9 per cent. in the latter only 3 per cent. Some gold and platinum were also found.

The diamonds were obtained from the chromite by fusion with sodium carbonate; and they have also been identified in their sections. They present two varieties, one a yellowish aggregate of very minute particles, the other well-formed octahedral crystals of great purity. It appears that the carbon was an original constituent in the peridotite magma, and crystallized out in solidifying, apparently before the chromite.

China.—Small diamonds are long known to have been picked up in the rice-fields after rains; but there is no definite knowledge as to their number or quality, as they are valued and retained among the natives. It is stated[1] that "black diamonds" of two or three carats are found in "two provinces in North China," through which provinces, is not stated. They are fairly brilliant, and harder than ordinary diamonds, and are prized by the natives as ornaments. This is believed to be the first announcement of the occurrence of black diamonds in China.

Arkansas.—In the year 1911 little was done at the diamond-field, owing to the lack of capital for active work. Two "pipes" are now determined, and probably a third is located. The Arkansas Diamond Co., which owns most of one of the recognized pipes, is endeavoring to raise the required capital. The washings have shown a yield of 28 carats of diamonds per hundred loads (of 16 cu. ft.); this, in the form adopted in the African reports, would be 0.28 carat per load, about the same as that of the Kimberley mine. But the diamonds are mostly small. One was obtained, however, from another part of the same pipe, known as the Mauney tract, that weighed 8 1/8 carats—a fine stone, the largest yet found in Arkansas; one or two others are also reported, of 2 or 3 carats' weight.

Illinois.—The occasional occurrence of diamonds in the glacial drift, along the line of the terminal moraine, from Wisconsin to Ohio, and again reported in Illinois, has led to the belief that there must be some source or sources for them in the Canadian wilderness Ungava, somewhere near James' Bay. A good deal of prospecting has been done at various points, but thus far with no definite result. Statements have been made in some newspapers, of diamonds being found in Ungava,

[1] Mr. Edward de Nilla.

and taken to New York and shown to the writer; but the reports have either lacked foundation, or the stones, though real, have had some uncertainty as to their actual source. An expedition has been organized and has lately started from Ottowa, with Indian guides, and ample supplies, to go up toward Hudson Bay, and explore the region during the present summer. The Illinois discovery above referred to, was in Jefferson Co., near Ashley, where several diamonds are said to have been found. The largest was a stone of 7 carats, and was sold to a firm in Alton, Ill., for $175.

Diamond-cutting Industry

The Industry has been on the whole quite a prosperous one in 1911. As before, the chief centers have been Amsterdam and Antwerp, of which the latter has increased. This is partly due to the fact that a Belgian syndicate had a contract for the output of the diamond field in German Southwest Africa. So far as the exports to America are concerned, many Amsterdam diamond dealers come weekly to Antwerp to sell their product for shipment from that port.

The fear felt of an overproduction has not been realized. The De Beers mine output is carefully regulated, so as not to exceed an annual amount of about 2,500,000 carats.

The regularly organized diamond workers in Amsterdam number about 10,000, representing some 70 establishments, beside a considerable body of unorganized workmen. In 1912, it is expected that 1000 apprentices will be added—most of them sons of the present operatives. Pupils pay large prices for instruction, even as much as $2000, for cleavers, payable in instalments; and the school for turners and polishers charged from $120 to $150. As soon as a pupil can do good work he begins to receive pay.

Small private cutting establishments are developing—with a consequent tendency to a lowering of prices.

Antwerp.—The reports received from the American consul-general at Antwerp, Mr. H. W. Diederich, give some interesting accounts of changes in the conditions of diamond-cutting in Belgium. The business has long been dominated by a syndicate, which, in particular, refused to permit apprentices. The coming-in of the large output from German Southwest Africa compelled an important increase in the number of cutters; but the syndicate would not modify its regulations. This led to a revolt in 1909. The movement has gone on, and spreading over Belgium, as Mr. Diederich says, independent diamond-cutting in small establishments is fast becoming a national industry. The independent workers are free to initiate their sons into the business.

From 1891 to 1911, the number of cutting establishments has advanced from 5 to 300, that of employees from 300 to 16,000, and that of diamond-brokers from 2 to 200. The wages paid to cutters in 1911, amounted to over $7,000,000, and the total volume of business to $48,000,000. This great increase is largely due to the imports of German-African diamonds, of which more than nine-tenths are taken up by a Belgian syndicate. How far this condition may be permanent, however, is not certain.

In exports of diamonds to America, Antwerp is ahead of Amsterdam, the value for 1911 having been $11,357,475 or about 13 per cent. more. This was $500,000 less than in 1910. Of this total, nearly two-thirds ($1,348,151) represented uncut stones, while in 1910 the uncut stones were less than half. This indicates the growth of cutting in the United States. There has been much talk as to a possible combination between the London syndicate, controlling the De Beers and Premier mines, and the German syndicate. But this does not seem very practicable. The character of the products is different. The Cape mines furnish all the larger-sized diamonds and control the market for them; but for the smaller stones (melées, as they are called in the trade) there is little demand in comparison. The German-African stones are all melées, and there are no larger diamonds to compete with the Cape output. At the same time, the German stones have gained much favor because of their brilliancy and their somewhat lower hardness, causing them to cut and polish more easily. The two syndicates are, therefore, not in competition.

The products of the several African mines, exhibited from time to time in London, are taken up almost as fast as they are displayed. A large share of the growing demand comes from the United States, but also a good deal from England itself, from France, and from some countries of Asia. Inferior grades of diamonds are rising in value with the prices of the finer stones.

It is of interest to note the statement that American-cut diamonds are in demand in all countries, being regarded as possessing the finest cutting and finishing.

At the present time it is estimated that the number of persons employed in this industry in various countries is about as follows: Belgium (as above) 16,000; Amsterdam, 8000–10,000; Germany, 1000; Switzerland, 400; London, 100; Paris, 100; New York, 300; Total, 25,900–27,900.

Although the diamond-cutting industry has made immense strides in the past few years, the year 1911 did not mark a continuance of the upward movement, there being, indeed, a very slight retrogression as appears in the following table:[1]

[1] From Consul General Henry W. Diedrich's report: *Daily Consular and Trade Reports*, p. 774; Feb. 21, 1912.

Quarters.	Cut Diamonds.		Rough Diamonds.		Total.	
	1910.	1911.	1910.	1911.	1910.	1911.
First	$ 2,907,064	$ 3,331,201	$ 134,727	$ 222,296	$ 3,041,791	$ 3,553,497
Second	2,373,125	2,701,961	222,561	317,713	2,595,686	3,019,674
Third	2,645,738	2,491,503	169,428	540,734	2,815,166	3,032,237
Fourth	2,135,916	1,484,659	268,479	267,408	2,404,395	1,752,067
	$10,061,843	$10,009,324	$795,195	$1,348,151	$10,857,038	$11,357,475

It will be noted, however, that the falling-off affected only the last quarter, the returns for the first three quarters showing an increase of $598,738 in the value of cut diamonds exported from Antwerp to New York; this was a little more than offset by a decrease of 651,257 in the last quarter. For both cut and rough, exports increased 518,437 over 1910. The exports from Amsterdam to New York in 1911 were but slightly less than those from Antwerp, being 10,080,851.

Agate.—The formation of agate chalcedony is exemplified in a specimen belonging to Herr Renck of Offenbach of enhydros still in the matrix. This enhydros has lost in volume through contraction (loss of water) and has thus become a so-called "rattling-stone." The enhydros is partially surrounded by a white, mealy mass, which should be amorphous silica. It is still fully embedded in a black, compact, fresh melaphyr; only one side being freed. A very narrow gap separates the enhydros from melaphyr. Traces of silica represent the beginning of a refilling of the gap.[1]

The writer believes it probable that in these formations the silica of the chalcedony shell was originally combined with the enclosed water and became freed therefrom. The separation of the silica from the main mass of water must have at first taken place on the surface, that is to say, a membrane must have been formed which soon became impervious to water. The enhydros crust did not arise by slow diffusion, but by a rather rapid precipitation.

Even in agate formation the outer crust formed is usually so firm that the mass retains its external form in spite of the loss of water. That is to say, the gap between melaphyr and agate is very slight. In agate very considerable internal contractions are to be noted. Indeed, in the enhydros also the filling of the cavity is scarcely ever complete, for a later cavity, the result of consolidation, allows the contents to be movable.

After an examination of thousands of agates and enhydros, the writer, however, believes that the enhydros were formed by moving heated waters that entered and passed from the gas pores in the igneous

[1] Raphale Ed. Liesegang and J. Rerick "Enhydros-Bildung" in *Centralbl. für Min. Geol. u. Palaontol.* 1912, No. 7, pp. 193–198.

rock that they formed in, and depositing layer after layer on the sides and at the minute entrance of the cavity eventually filled the opening and sealed the contents of water for endless time.

Emerald.—The occurrence of true emeralds in the northwestern part of South Carolina, has been known for some years;[1] but no actual locality has been known. There are translucent deep-green emeralds, cut and set, in the hands of individuals in South Carolina; but no mining has been done. A company has been formed to develop a property of 165 acres near Earle station, just south of the North Carolina line, which is believed to contain emerald deposits.

The Turner emerald mine in Cleveland Co., N. C., from which a number of fine gems have been obtained within the past 3 years, has been described by Mr. Douglas B. Sterrett.[2] He remarks (p. 26) that rock associations very similar in character to those containing emerald at the Turner mine, occur at a number of points in the region south of Shelby, N. C. This is quite near the border, it is probable that an emerald-bearing zone will be found to extend through this section of the two Carolinas.

The special conditions under which emeralds are formed, as brought out in this report, appear to be as follows. The region is one of Archean rocks—the Carolina gneiss, with igneous and granitic intrusions, not positively determined as to age, but the granite latest. These veins and lenses of pegmatite contain beryl and in some cases the true emerald. These are found only when the pegmatite traverses certain basic rocks—such as gabbro—which are found on analysis to contain a constant amount of oxide of chromium—0.16 to 0.19 per cent. This oxide, the coloring-matter of the emeralds, was evidently taken up into solution from these rocks by the pegmatite. If it contained the beryllium oxide necessary to form beryls, emerald then resulted. But only a fraction of the pegmatites are beryl-bearing; and hence the combination of two very special conditions was requisite to develop emerald.

Jade.—The natives of New Zealand have long used and greatly prized the green nephrite, to which they gave the name of *pounamu.* They obtained it from boulders along the west shore of South Island and in streams flowing down to that coast from the unexplored interior. Within recent years there has been careful search by prospectors and official geologists, for the source whence these boulders came; and some excellent localities have been found in the region of Milford Sound and up the Arahura and Greenstone Rivers. A considerable amount of true "greenstone" or pounamu has been taken out, and some of it exported

[1] 16th Ann. Rep. U. S. G. S., *Min. Res. of the U. S.*, Pt. IV, p. 600.
[2] *Min. Res. U. S.*, 1910, pp. 23–25, and 1911, pp. 19–26 (preliminary).

to be cut in Germany. The stone has hitherto been prized by the Maoris, but of late it is coming into favor among the more advanced races.

The Maoris had special names for different varieties of pounamu. One known by them as "tangiwai," the queen of greenstones, is an entirely distinct mineral. It was found to be bowenite, a variety of serpentine, very pale greenish in color, to almost white, and much more translucent than the nephrite which is a variety of amphibole. A very interesting discovery has been made within the past year, of what is probably the long-lost source of tangiwai. The new discovery corresponds closely with the place indicated by the native traditions. Samples of the stone taken to Auckland have been recognized by Maoris as the genuine *tangiwai*. Prof. Marshall, F. G. S., of Otago University, has examined the material and pronounced it to be bowenite "of unequaled quality" for all ornamental purposes.

The practical importance of this discovery lies in the fact that a ledge will yield not only pieces for all kinds of small objects, but masses of larger size. Characteristic cloudy waves, which add to its beauty, and are not easily imitated. Glass imitations of jade are found in the market in Europe.

Bowenite occurs in the United States, at Smithfield, Rhode Island, and is familiar to mineralogists, and it is known also in India, in the Punjab, where it is worked into small ornaments, as in New Zealand; but heretofore it has been obtained only in very limited amounts, and not very translucent. This newly-discovered locality promises an ample supply of this beautiful stone for export to America and Europe, and especially perhaps to China and Japan, where jade of all kinds has long been a material peculiarly esteemed.

Opal.—The Japanese opal locality, discovered in 1905, is situated at Takarasaka, in the prefecture of Fukishima. It is now being worked by the Tokio Hosaka Kaisha, Ltd. The matrix rock is reported to be a perlite; several varieties of the mineral are found—milk-opal, opal-agate, precious opal, glass-opal (hyalite?) and smoky or granitic opals. The precious opal is stated to resemble the Hungarian mineral; but a marked variety is one that is entirely transparent and colorless, but presents orange or emerald-green colors when seen at certain angles of light. The stone here has a specific gravity of 2.22 (typical) and a water-content of 8.49, with no extraneous matter.

The great extent of volcanic rocks throughout the far northwest furnishes many localities where this beautiful gem-stone may be found. In the author's reports to the Interior Department from 1890 to 1905, some sixteen distinct occurrences were noted.

There have at various times come to me specimens of opal from near Lovelock, in the southern part, and wood opal from the northeastern part of Humbolt Co., Nevada; also, opal in concretionary masses from Austin, Nevada. In Idaho, opal comes from Caldwell, and from Rockville, and Squaw creek, Owhyee County, and from Clover creek, Lincoln County in the Snake River region in the southwestern part of the state; and from near the Salmon River, from Baker and Durkee in Oregon, and from Walla Walla, Douglas County, and Whelan, Washington, (near Mexico, Idaho).

For the past 25 years small specimens of opal as float have been found near the junction of southwest Idaho, southeast Oregon, and northern Nevada. Opals from Drewsey, Oregon, have been described by the writer and also specimens from northern Washington. In 1889, there was found in John Day River a specimen of good fire-opal 1 in. long, 1/2 in. wide and 1/4 in. thick, a drift pebble, either out of some gravels or a river bed. The color was excellent and quite equal to the pale yellow fire-opal from Queretaro, Mexico.

About 3 years ago some specimens of fire-opal were found in northern Nevada, at Virgen valley, west of the Santa Rosa Mountains. This resembled certain types of the Mexican opal from Queretaro, though not precious opal such as was found in Washington State. Of these Nevada opals some are absolutely transparent and pellucid, either with large flames of color, or with a smaller harlequin flaking. These change gradually into pale yellow, yellow-brown and brown, and sometimes are only sub-translucent but with a great play of color, finally becoming almost black. These dark varieties include some strongly resembling the hue of certain crude petroleums, or that of the darker types of Burman or Roumanian amber.

More recently another locality has been found 8 miles from the above. This has furnished a number of specimens remarkable for their large flames of red, strongly resembling lumachelle marble. A number of these are lusterless and many of them are more or less cracked, partly due to the fact that they have a large water content, and partly because they have been mostly found very near the surface. In one respect, this occurrence resembles the deposits at White Cliffs, New South Wales, in that, as there, some of the opals are pseudomorphous after wood or other objects,. There was a newer find in 1911, a limb of a tree measuring 50 cm., or nearly 2 ft. in length and 8 cm. across, entirely replaced by opal; the outer parts were very brilliant, while the center was of the dull, common opal variety.

In nearly every instance these masses are found in decomposed volcanic rock, or in ash that has hardened. Apparently there must have

been a later flow of siliceous waters to change them to this form. The deposit is west of the Santa Rosa Mountains and near the Trout Forest Range and the Pine Forest Range. Some of the stones cut several years ago still hold their color, but it is possible that a number of them may not be of the more durable type. This is the most interesting occurrence of opal that has yet been noted in the United States. The deposit found in 1909 was traced to a depth of 16 ft., whereas the opalized tree and later deposits above mentioned were found at a depth of only 2 ft.

These opals were described by the writer before the N. Y. Academy of Sciences, on Nov. 6, 1911, and specimens exhibited. More material has since been obtained, of the same kind but even finer. Nowhere have more elegant opals been found, or better examples of the opaline replacement of wood. No trace of vegetable structure remains visible. The outer portion often breaks off with a beautiful pisolitic or small mammillary surface. The variety of colors and types of opal is very remarkable here; the dark browns, like fluorescent petroleum; dark with broad flames of color; or shot through with brilliant little lines and streaks of fire in a field of pale purple or blue; another type is a hazy or misty white with brilliant play of colored fire; and again with the transparency of water.

Gems of over 20 carats have been obtained here, and a great many of like dimensions. The question of durability is an important one with opals. A good proportion of these appear to hold their color well and remain unchanged; though some show a tendency to fracture after a time. These are of the fire-opal variety, an opal with a high water content.

Rhodonite.—A fine quality has been found at a locality in Josephine Co., Oregon, some 30 miles west of Grants' Pass. Specimens are of rich cherry red, and of darker shade, and local collectors have obtained handsome pieces. It is said all to come from a large vein.

A remarkable crystal of rhodonite (Fowlerite) from Franklin, N. J., has been acquired by the Brush mineralogical cabinet at New Haven, Conn. It is described by W. E. Ford and R. B. Crawford.[1] The crystal is unusually rich in faces, and one new face was determined, v, $(0\bar{4}1)$, and another, k $(2\bar{2}1)$, which had been reported before, but doubtfully.

Sapphire.—These have been in favor of late in jewelry, and the production from the Yogo Gulch, Montana, mines on Judith River, has gone on quite successfully. Montana stones are often not so dark or turbid as some of the oriental stones; and the desirable stones retain their blue color by artificial light. The season in 1911 was more favorable than in

[1] *Amer. Journal Science* (4), XXXII, p. 289 (Nov., 1911).

1910; water was abundant without damaging cloudbursts. The output therefore showed considerable increase, amounting, for the two companies engaged there, to some 500,000 carats. Of these, about 18 per cent. were suitable for cutting as gems, the rest being available, as usual, only for watch jewels. Some exceptionally fine sapphires were obtained, in particular two stones of rich cornflower blue, weighing 2 1/2 and 3 1/2 carats respectively, and bringing record prices.

Turquoise.—An important discovery has lately been made, of definitely crystallized turquoise, occurring at Lynch station, in Campbell Co., Va. A full account, with analysis and crystallographic details, is given by Mr. Waldemar T. Schaller.[1]

The mineral occurs in a matrix of glassy quartz, broken up into irregular fragments, united by the turquoise, which fills the interstices, and in some cases shows a botryoidal surface with minute drusy crystals. The turquoise is of a fine blue color, and the mass polishes well into a handsome ornamental "matrix" stone.

The crystals are clear and brilliant; few exceed 1/3 in. in diameter; and being closely aggregated, measurement is difficult. Some were determined, however, as triclinic, practically imomorphous with chalcosiderite.

Analysis gave the composition of true turquoise, corresponding to the formula CuO, $3Al_2O_3$, $2P_2O_5$, $9H_2O$.

This, Mr. Schaller feels satisfied to be the correct expression for the composition of this species. The following are the actual analyses, with those given by Prof. Penfield for a turquoise from Nevada.[2] The density is approximately 2.8.

	Virginia.	Nevada.
P_2O_5	34.13	34.18
Al_2O_3	36.50	35.03
Fe_2O_3	.21	1.44
CuO	9.00	8.57
H_2O	20.12	19.38
Insoluble	.....	.93
	99.96	99.53

The face of the mineral now being found, for the time, definitely crystallized, disposes of the question regarding the character of turquoise as a true mineral species. Mr. Schaller alludes to the other theory of its being a mixture of a copper and an aluminum phosphate, saying that these specimens give no support to it. The close agreement of the analysis, moreover, with that given by Prof. Penfield, which was itself

[1] *Amer. Jour. Sci.*, Jan., 1912.
[2] *Amer. J. Sci.*, Nov., 1900.

coördinate with a number of others from various localities, confirms and doubtless establishes this view.

Mr. Sidney Paige, in *Economic Geology*, for June, 1912 (Vol. VII, No. 4, p. 382), discusses the occurrence of turquoise in the Burro Mts. of New Mexico. The turquoise is confined to a very moderate depth, within the zone of alteration; while the apatite appears lower down. The phosphoric acid has no doubt come from the latter, the copper from the sulphide ores, and the alumina from the sericitic alteration of feldspars in the granite rocks, all as a result of erosion and weathering.

Zircons.—Specimens of Zircon have been brought from Campbell Island, some 300 miles south of New Zealand, about in W. long. 70° and between 52° and 53° S. lat. The specimens are small rounded nodules, some of them showing obscure crystalline form, but remarkable for their brilliant polish or luster; they are clear and of a rich hyacinth-red color, and would cut into small but very handsome gems.

Amber.—An exhaustive search for deposits of amber in Russia has been carried on recently by three Belgian mining experts. The best results were secured in the Volhynia and Minsk Governments, where amber was found in considerable quantities near Dombrovitza, on the Rovna district, at Goryni and near the village of Barashi in the Zhitomir district. It is believed that on further investigation these deposits will be found worthy of exploration, especially in view of the progressive exhaustion in Western Europe.[1]

Prof. Dr. Richard Klebs, connected with the Royal Geological Survey, and scientific adviser to the Royal Amber Works,[2] gathered and owned the great collection which was exhibited under the auspices of the Imperial German Government at the St. Louis Exposition in 1904. This great collection consists of 10,000 inclusions in amber, comprising beetles, flies, spiders, wood, leaves, and many other interesting objects. It has been held at $40,000 and will not be divided.

The last paper he wrote[3] appeared in the "*Schriften der physik.-ækonom. Gesellschaft zu Königsberg*, i Pr." Jahr. LI, pp. 217–242, III, 1910, and describes these fossils with illustrations.

Pearls.—It is evident from the recent reports of the Ceylon Company of Pearl Fishers that this venture has been very unsuccessful. A total deficit of £118,517 on operations up to the present time is reported. Naturally, the company is seeking for a modification of the terms of its lease with the Government of Ceylon, and the latter is said to be inclined to accord this, should the annual inspection reveal the presence of a

[1] Résumè from the *Mining Journal*, Vol. XCVI, No. 3994, p. 228; London, March 9, 1912; citing (merely by name) the Russian Universal Technical Review.
[2] Died in Königsberg, Prussia, June 20, 1911, in his sixty-seventh year.
[3] "Ueber Bernsteineinschlüsse im Allgemeinen und die Coleopteren meiner Bernsteinsammlung."

spat-fall, and should the application of wire netting to defend the young oysters from the attacks of predatory fish be efficacious.

The periodical disappearance of the oysters from the Ceylon pearl-banks, often for a number of years at a time, has been an element of uncertainty. Mr. Hugh M. Smith, U. S. Deputy Commissioner of Fisheries, in an extended article on the Ceylon pearl-fishery,[1] stated that in the last century pearl-fishing was possible in only 36 years, the barren intervals varying from a few years to as many as 16. The curious fact appears, from recent studies, that the destructive fishes themselves have a part in the actual production of the pearls. The latter are formed in the tissues of the young shell-fish by the secretion of nacre as an envelope around the bodies of small encysted parasitic worms (custoids), which enter the shells and penetrate the tissues and thereby cause irritation to the mollusc. They do not develop further in the pearl-oyster, and those that die form the nuclei of pearls. But if the molluscs are eaten by fishes, the encysted larvæ reach maturity to repeat the same cycle of life-history. Even were it possible in any way to keep the fish from access to the pearl-banks by wire netting, as proposed, this attempt might only defeat its own object.

The Ceylon pearls are extremely numerous and many of them very small as explained by the manner of their origin—the "seed-pearls" of commerce.

A serious problem has arisen in the pearl industry of Australia, in consequence of the decision of the Government that after January 1, 1913, only white men may be employed as divers and tenders. This work has hitherto been done by Malays and Japanese. U. S. Consul J. F. Jewell, of Melbourne, states that there is much concern and doubt among the pearlers, as to how far this change can be accomplished. Many of the pearl-banks lie beyond the 3-mile territorial limit; and if the new method is not successful, it is feared that the industry may pass into foreign hands. The Pearlers' Association of Broome, Western Australia, has laid before the Premier of that State a project for training white men for the work of pearl-diving. A committee in London is also going to endeavor to get men from northern Europe to meet the Australian need.

[1] *National Geographic Magazine*, Feb., 1912.